PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-321395
(43)Date of publication of application : 12.12.1997

(51)Int.Cl. H05K 1/02
H05K 1/05
H05K 3/00

(21)Application number : 08-136211
(22)Date of filing : 30.05.1996

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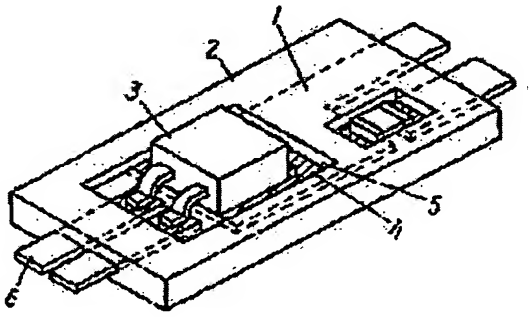
(54) HEAT DISSIPATION BOARD FOR MOUNTING ELECTRONIC DEVICE AND MANUFACTURE THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance both heat dissipation characteristics and insulation characteristics of a heat dissipation board by molding a metal plate punched into a specified wiring pattern, while exposing the device mounting part thereof, integrally with a composite insulating material having high thermal conductivity.



SOLUTION: A metal plate 1 punched into a wiring pattern is molded, while exposing the electronic device 3 mounting part thereof, integrally with a composite insulating material having high thermal conductivity. Since the wiring pattern is formed by punching the metal plate 1, the heat dissipation board has low wiring resistance and the heat generated from the mounted electronic device 3 is diffused through the metal plate 1 punched into a wiring pattern and then dissipated through the composite insulating material 2 having high thermal conductivity thus realizing excellent heat dissipation characteristics. Since the insulation layer is thick, excellent insulation characteristics can be ensured even when an external heat sink is employed while reducing the distributed capacitance between the patterns. According to the arrangement, both the heat dissipation characteristics and the insulation characteristics of a heat dissipation board can be enhanced.

LEGAL STATUS

[Date of request for examination]	24.03.2003
[Date of sending the examiner's decision of rejection]	30.05.2006
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is the heat dissipation substrate for electronic-parts loading with which it was constituted by the metal plate and the compound insulating material of high temperature conductivity which were pierced in the shape of [predetermined] a circuit pattern, and the compound insulating material of said high temperature conductivity carried out unification formation of said metal plate where [of this metal plate] an element-placement part is exposed at least.
[Claim 2] The heat dissipation substrate for electronic-parts loading according to claim 1 which is in the condition of a metal plate in which the element-placement part was exposed at least, and really formed the compound insulating material in vertical both sides of said metal plate so that the cavity in which components receipt is possible might be constituted.
[Claim 3] The heat dissipation substrate for electronic-parts loading according to claim 2 which really formed the compound insulating material so that a height might be arranged on a front face, while arranging to vertical both sides of said metal plate, where [of a metal plate] an element-placement part is exposed at least.
[Claim 4] A metal plate is a high temperature substrate for electronic-parts loading according to claim 1 which bent at least to the part, performed processing or spinning while piercing in the shape of [predetermined] a circuit pattern, and was made to project rather than the flat surface of said metal plate.
[Claim 5] The heat dissipation substrate for electronic-parts loading according to claim 1 which really formed the compound insulating material where some metal plates [at least] are exposed, and used said some of metal plates as the terminal.
[Claim 6] A metal plate is a heat dissipation substrate for electronic-parts loading according to claim 5 which bent the part at least inside the appearance of the really fabricated Plastic solid of the compound insulating material of high temperature conductivity, and was used as the terminal.
[Claim 7] In the approach of manufacturing the heat dissipation substrate which holds the metal plate pierced in the shape of [predetermined] a circuit pattern to metal mold, and really fabricates it by the compound insulating material of high temperature conductivity The element-placement side side of said metal plate in the cavity of said metal mold exposes an element-placement part at least, and is held by the height of the configuration in which components receipt is possible. It holds by the height which carries out movable about the radiator by the side of the heat sinking plane of said metal plate by which external is carried out at least, and the circuit pattern which needs an insulation. It is the manufacture approach of the heat dissipation substrate for electronic-parts loading which is made to move said height which carries out movable at the same time the compound insulating material of said high temperature conductivity carries out the completion of restoration into the cavity of metal mold, and is really fabricated so that the required circuit pattern of said insulation may not be exposed to a heat sinking plane side.
[Claim 8] The manufacture approach of the heat-dissipation substrate for electronic-parts loading according to claim 7 of having changed partially the thickness of an insulating layer which holds the metal plate pierced in the shape of [predetermined] a circuit pattern to metal mold, performs level difference processing in the approach of manufacturing the heat-dissipation substrate really fabricated by the compound insulating material of high-temperature conductivity, to some metal plates [at least] pierced in the shape of [said / predetermined] a circuit pattern, really fabricates by

the compound insulating material of said high-temperature conductivity, and consists of composite material of said high-temperature conductivity.
[Claim 9] It is the manufacture approach of the heat dissipation substrate for electronic-parts loading according to claim 7 which formed recessing inside the outcrop of said element-placement part while piercing said metal plate in the shape of [predetermined] a circuit pattern in the approach of manufacturing the heat dissipation substrate which holds the metal plate pierced in the shape of [predetermined] a circuit pattern to metal mold, and really fabricates it by the compound insulating material of high temperature conductivity.
[Claim 10] The process which pierces a metal plate in the shape of [predetermined] a circuit pattern, and said metal plate are held in metal mold. The process which slushes the compound insulating material of high temperature conductivity fused to this metal mold, and really fabricates said metal plate on a substrate by the compound insulating material of said high temperature conductivity in the condition of having exposed the element-placement part at least, The manufacture approach of the heat dissipation substrate for electronic-parts loading which serves as a process which connects components to the really [said] fabricated substrate electrically, and a process which bends said some of metal plates and is processed into a terminal according to a wrap process in said component with a case or resin.
[Claim 11] The manufacture approach of the heat dissipation substrate for electronic-parts loading which puts, heats and solders the heat dissipation substrate which has arranged solder and components to said foil body front face of the heating means constituted by the foil body arranged on the front face of at least one or more liquid tubs by which the temperature control was carried out, and said liquid tub.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the heat dissipation substrate for electronic-parts loading carrying a power semi-conductor, various electronic parts, etc. which are used for the electronic-circuitry module which treats large power like an inverter circuit or a power circuit, and its manufacture approach.
[0002]
[Description of the Prior Art] In recent years, as for the electronic circuitry which treats large power like an inverter circuit or a power circuit, the modularization is progressing with the miniaturization of a device. In order to attain the modularization of this power electronic circuitry, it is an important technical problem how heat is radiated in generation of heat by loss of the power semi-conductor by which high density assembly was carried out. By etching lamination and this conductive foil into this kind of electronic-circuitry module for conductive foil through a thin insulator layer on the front face on a metal support plate conventionally, the substrate (a metal base substrate is called below) which forms a circuit pattern was used, a power semi-conductor and various electronic parts were carried in this, and the circuit was formed.
[0003] Drawing 16 and drawing 17 explain this conventional electronic-circuitry module. Drawing 16 and drawing 17 show the electronic-circuitry module using the conventional ******-SU substrate. According to this drawing, 91 is a metal support plate and electronic parts with which an insulator layer and 93 contain conductive foil and, as for 92, 94 contains a power semi-conductor. Conductive foil 93 is stretched by the metal support plate 91 through the insulator layer 92. This conductive foil 93 is formed in the shape of a circuit pattern of etching, carries electronic parts 94 in this, and constitutes a circuit. 95 is an external connection terminal and is carried like electronic parts 94. Generation of heat with electronic parts 94 is told to the metal support plate 91 through the insulator layer 92. A bus bar for 96 to reduce wiring resistance of a pattern and 97 are radiators, and they are used in order to compensate heat dissipation, when heat dissipation of only the metal support plate 91 is inadequate.
[0004]
[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional configuration, in order to form a circuit pattern by etching, thin things, such as 35 micrometers and 70 micrometers, are used for conductive foil 93, and in case a power circuit where a high current flows is constituted, the wiring resistance poses a problem. For this reason, the bus bar 96 is mounted in the part which there are many currents and flows at the substrate. Moreover, the heat dissipation property of this metal base substrate is determined by the insulator layer 92 formed between the metal support plate 91 and conductive foil 93, and this kind of insulator layer 92 is formed by spreading of an epoxy resin, and generally, in order to improve a heat dissipation property, it is fabricated thinly. For this reason, since the distributed capacity generated between that an insulating property is not made highly, and conductive foil 93 and the metal support plate 91 became large, the technical problem that RF-ization of a circuit was checked or it was easy to spread a noise through the metal support plate 91 occurred. Furthermore, the external connection terminal 95 in the case of constituting a module needed to be mounted in the substrate by another parts, and it also had the technical problem that positioning of two or more external connection terminals was difficult.

[0005] Reduction of the distributed capacity of the circuit pattern used as the reduction of wiring resistance and the cause of a noise which become important [this invention] when the electronic circuitry of large power is constituted at the same time it solves the above-mentioned conventional technical problem and improves both the heat dissipation property which is a property with an important heat dissipation substrate, and an insulating property is attained. It is the possible heat dissipation substrate of the spacial configuration which can unify an external connection terminal etc., and aims at offering the heat dissipation substrate for electronic-parts loading easily realizable moreover, and its manufacture approach.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention pierces a metal plate in the shape of [predetermined] a circuit pattern, where an element-placement part is exposed at least by the compound insulating material of high temperature conductivity, it really fabricates this metal plate, and constitutes a heat dissipation substrate.
[0007] Since a circuit pattern is a metal plate, wiring resistance is low with a natural thing, and it is suitable for the high current circuit with this configuration. Moreover, once thermal diffusion of the generation of heat of the components mounted in this substrate is carried out by the metal plate, since heat dissipation nature consists of compound insulating materials of high temperature conductivity good in order to radiate heat by the compound insulating material of high temperature conductivity, since an insulating layer is made thickly, its insulation improves, and it is that the distributed capacity between patterns can also be reduced. Furthermore, since a metal plate is pierced and really fabricates the compound insulating material of high temperature conductivity to this using processing, it can be carried out easily, and with the conventional heat dissipation substrate, the difficult three-dimensional structure of it also becomes possible.
[0008]
[Embodiment of the Invention] Invention of this invention according to claim 1 is constituted by the metal plate and the compound insulating material of high temperature conductivity which were pierced in the shape of [predetermined] a circuit pattern. Since it radiates heat by the insulating material of high temperature conductivity after carrying out thermal diffusion of the compound insulating material of said high temperature conductivity with said metal plate by having really formed said metal plate where [of this metal plate] an element-placement part is exposed at least, While heat dissipation nature becomes good, the distributed capacity of said circuit pattern can also be reduced.
[0009] Invention of this invention according to claim 2 constitutes the cavity in which components receipt is possible by the compound insulating material according to claim 1, and makes positioning of the electronic parts to carry easy.
[0010] Invention of this invention according to claim 3 prepares a height in the perimeter of a front face of the heat dissipation substrate for electronic-parts loading by the compound insulating material according to claim 1, and can form very easily the improvement in on the strength of a substrate, and the fitting section with a case.
[0011] While invention of this invention according to claim 4 pierces a metal plate according to claim 1 in the shape of [predetermined] a circuit pattern, bend it at least to a part, it performs processing or spinning, is made to project rather than the flat surface of said metal plate, and it enables improvement in on the strength of a heat dissipation substrate with a metal plate.
[0012] Invention of this invention according to claim 5 uses some of metal plates according to claim 1 as a terminal, and does not have the need of preparing a terminal area separately.
[0013] Invention of this invention according to claim 6 bends the part at least inside the appearance of the Plastic solid of the compound insulating material of high temperature conductivity which really fabricated the metal plate according to claim 5, considers as a terminal, secures the creeping distance with the chassis and radiator which are connected to a rear face, and raises the withstand voltage from a circuit.
[0014] In the approach of manufacturing the heat dissipation substrate which invention of this invention according to claim 7 holds the metal plate pierced in the shape of [predetermined] a circuit pattern to metal mold, and is really fabricated by the compound insulating material of high temperature conductivity The element-placement side side of said metal plate in the cavity of said

metal mold exposes an element-placement part at least, and is held by the height of the configuration in which components receipt is possible. It holds by the height which carries out movable about the radiator by the side of the heat sinking plane of said metal plate by which external is carried out at least, and the circuit pattern which needs an insulation. Said height which carries out movable can be moved while the compound insulating material of said high temperature conductivity carries out the completion of restoration into the cavity of metal mold, and the required circuit pattern of said insulation is really fabricated so that it may not expose to a heat sinking plane side, it is very efficient and can manufacture the heat dissipation substrate for electronic-parts loading.

[0015] In the approach of manufacturing the heat dissipation substrate which invention of this invention according to claim 8 holds the metal plate pierced in the shape of [of claim 7 / predetermined] a circuit pattern to metal mold, and is really fabricated by the compound insulating material of high temperature conductivity Level difference processing is performed to some metal plates [at least] pierced in the shape of [said / predetermined] a circuit pattern. It really fabricates by the compound insulating material of said high temperature conductivity, and the thickness of an insulating layer it is thin from the composite material of said high temperature conductivity is changed partially, the heat dissipation property of components that exoergic components are arranged can be raised, or improvement in substrate reinforcement can be aimed at.

[0016] Holding the metal plate which pierced invention of this invention according to claim 9 in the shape of [of claim 7 / predetermined] a circuit pattern to metal mold, in the approach of manufacturing the heat dissipation substrate really fabricated by the compound insulating material of high temperature conductivity, said metal plate forms recessing inside the outcrop of an element-placement part while piercing it in the shape of [predetermined] a circuit pattern, and it prevents invasion of the compound insulating material at the time of shaping to exposed circles.

[0017] The process at which invention of this invention according to claim 10 pierces a metal plate in the shape of [predetermined] a circuit pattern, The process which holds said metal plate in metal mold, slushes the compound insulating material of high temperature conductivity fused to this metal mold, and really fabricates said metal plate on a substrate by the compound insulating material of said high temperature conductivity in the condition of having exposed the element-placement part at least, The process which connects components to the really [said] fabricated substrate electrically, the process which bends said some of metal plates and is processed into a terminal, and a case or resin constitutes said component from a wrap process, and the heat dissipation substrate for electronic-parts loading in which electronic parts were carried efficiently can be manufactured.

[0018] Invention of this invention according to claim 11 improves adhesion with a heat dissipation substrate while it puts, heats and solders the heat dissipation substrate which has arranged solder and components to said foil body front face of the heating means constituted by the foil body arranged on the front face of at least one or more liquid tubs by which the temperature control was carried out, and said liquid tub and prevents adhesion of the charge of sap-wood in a liquid tub by the foil body.

[0019] Hereafter, drawing 1 - drawing 15 explain the gestalt of 1 operation of this invention.

(Gestalt 1 of operation) Drawing 1 and drawing 2 are drawings showing the heat dissipation substrate for electronic-parts loading of the gestalt of the 1st operation, drawing 1 is a perspective view and drawing 2 is a sectional view. In drawing 1 , 1 is the metal plate pierced in the shape of a circuit pattern, and can be easily realized by using a press machine as a means to be desirable as for a copper plate with thermal conductivity and conductivity good as a metal plate 1, to pierce in the shape of a circuit pattern, and to process it. 2 is the compound insulating material of high temperature conductivity, and this is the ingredient which can perform insert molding of a metal plate 1 by injection molding or transfer molding. The thermosetting epoxy resin which has high thermal resistance so that soldering of electronic parts may be possible as a resin ingredient of the base Or thermoplastic polyphenylene sulfide, a liquid crystal polymer, Either or such mixture of polystyrene and nylon are used. Oxidation aluminum, nitriding aluminum which have insulation and high temperature conductivity into this base resin ingredient, The mixture chosen from the inside of magnesium oxide, boron nitride, a zinc oxide, a silica, a titania, a spinel, or these Titanium, It is the compound insulating material which kneaded the bulking agent which makes a subject the fine-particles filler and fibrous fillers, such as glass and a whisker, which carried out surface treatment by coupling agents, such as a silane, and raised thermal conductivity and reinforcement.

[0020] A cavity for the outcrop of the metal plate 1 for the electronic parts with which 3 was carried in the heat dissipation substrate, and 4 to connect electronic parts 3 electrically, and 5 to carry electronic parts 3, and 6 are the terminal areas which used the metal plate 1. In drawing 2 , 7 is an external radiator used only with a heat dissipation substrate when heat dissipation is not enough. Where the loading part of electronic parts 3 is exposed, unification shaping of the metal plate 1 pierced in the shape of a circuit pattern by such compound insulating material 2 of high temperature conductivity is carried out.

[0021] Since the heat dissipation substrate constituted as mentioned above is the metal plate 1 into which the circuit pattern pierced and was processed, its wiring resistance is low, and after thermal diffusion is carried out by the metal plate 1 pierced in the shape of a circuit pattern, since generation of heat of the mounted electronic parts 3 radiates heat by the compound insulating material 2 of high temperature conductivity, it is excellent in the heat dissipation property. Moreover, when using the external radiator 7, since the insulating layer is thick, an insulating property is that it is good and the distributed capacity between patterns can also be reduced. Furthermore the component-mounting part of a metal plate 1 is exposed, and while positioning of components becomes easy by constituting the cavity 5 for loading by the compound insulating material 2 of high temperature conductivity, the resist for prevention of a solder bridge becomes unnecessary.

[0022] Moreover, since the mold of the metal plate 1 is carried out by the compound insulating material 2 of high temperature conductivity, while its degree of adhesion improves, it has an advantage on the substrate configuration that the camber of the substrate accompanying contraction of the resin after shaping is reduced since the compound insulating material 2 of high temperature conductivity is arranged at the both sides of a metal plate 1. Although the circuit pattern formed in the further conventional substrate front face needed to secure the predetermined creeping distance for the insulating reservation between patterns, since a circuit pattern is embedded at the compound insulating material 2 of high temperature conductivity, according to this configuration, it becomes possible [also narrowing pattern spacing].

[0023] Drawing 3 and the example which has improved in the gestalt of the 1st operation to drawing 4 are shown. Drawing 3 shows the example which formed the height 8 of the shape of a frame by the compound insulating material 2 of high temperature conductivity in the front face of a heat dissipation substrate. By constituting such a height 8, it is also possible to give various functions called the configuration of the fitting section with reservation, a case, etc. of the creeping distance required for the improvement in on the strength and an insulation of a heat dissipation substrate, and, moreover, metal mold can attain these configurations easily.

[0024] Drawing 4 shows the example which bent to the metal plate 1 and formed the processing section 9. Such bending processing and spinning can perform improvement in on the strength of a heat dissipation substrate. Moreover, it is also possible to give the positioning function of electronic parts 3 also by processing of such a metal plate 1. The metal mold of a press can also constitute processing of this kind in formation and coincidence of a circuit pattern. Thus, the heat dissipation substrate of this configuration can realize difficult three-dimensional processing easily in the conventional heat dissipation substrate.

[0025] In addition, the thickness of the copper plate as a metal plate 1 has 1.0 desirablemm or less, when the workability in the case of 0.5mm or more being desirable and carrying out pattern formation with metal mold using a press machine, if the reinforcement when constituting the thermal diffusion effectiveness and a terminal is taken into consideration is taken into consideration. moreover -- the component side of a copper plate is good in soldering nature by plating -- it can carry out -- a base -- melanism -- the adhesion with the compound insulating material 2 of the metal plate 1 and high temperature conductivity in damaging a front face by processing or blasting processing improves. Since the compound insulating material 2 of high temperature conductivity really enters even into said hole processing section by performing hole processing partially at the time of shaping when the pattern area of a metal plate 1 is still larger, adhesion is further improvable.

[0026] (Gestalt 2 of operation) It explains, really referring to a drawing about the shaping approach as a gestalt of operation of the 2nd of this invention below. Drawing 5 and drawing 6 are the sectional views showing the one shaping approach of (the gestalt 1 operation). In drawing 5 , the

metal plate which pierced 1 in the shape of a circuit pattern, and 11 The 1st metal mold, The cavity which prepared 12 in the 2nd metal mold and prepared 13 in the 1st metal mold 11 and 2nd metal mold 12, A height for a height for 14 to fix the metal plate 1 formed in the 1st metal mold 11 and 15 to fix the metal plate 1 formed in the 2nd metal mold 12, the notching section which prepared 16 in the point of a height 15, and 17 are the springs for holding the condition that the height 15 projected from the 2nd metal mold 12. In drawing 6 , 2 is the compound insulating material of high temperature conductivity slushed into the cavity 13.

[0027] The one shaping approach using the metal mold constituted as mentioned above is explained concretely. A metal plate 1 is held within a cavity 13 by the height 14 prepared in the 1st metal mold 11, and the height 15 prepared in the 2nd metal mold 12. A metal plate 1 and one shaping of the compound insulating material 2 of high temperature conductivity are attained by slushing the compound insulating material 2 of high temperature conductivity fused to the cavity 13 in this condition. By considering as the configuration which can components contain a height 14 here, some metal plates 1 are exposed and the cavity 13 in which components receipt is possible can be constituted in the Plastic solid of the compound insulating material 2 of high temperature conductivity. Moreover, a pressure is added and a height 15 is depressed, after the compound insulating material 2 of high temperature conductivity fused in the notching section 16 prepared in the point carries out the completion of restoration into a cavity 13. Since the compound insulating material 2 of high temperature conductivity of the thickness according to the movement magnitude of a height 15 is arranged by this at a metal plate 1, a metal plate 1 is not exposed to this field.

[0028] In addition, the height 15 is possible also for making it slide more mechanically than the exterior, and becomes unnecessary [the notching section 16] at this time.

[0029] Drawing 7 , drawing 8 , and drawing 9 are the sectional views showing the example improved about the above-mentioned one shaping approach. When the number same about the same thing as drawing 5 and drawing 6 is attached in drawing 7 , drawing 8 , and drawing 9 and the explanation is omitted and explained, a different point from drawing 5 in drawing 7 is in the point of having formed the level difference processing section 18 in the metal plate 1. The insulating layer formed in the rear face of a metal plate 1 of the compound insulating material 2 of high temperature conductivity has 0.4mm or more more desirable than the insulating property and resin reinforcement. However, substrate reinforcement becomes weak while it is difficult for you to make it filled up with the compound insulating material 2 of high temperature conductivity which became high [viscosity] by addition of a bulking agent, when all the rear faces of a metal plate 1 are set to 0.4mm. Moreover, since a heat dissipation property will get worse if said insulating layer is thickened, it has the technical problem of the repulsion of wanting to make it thin as much as possible. Then, the level difference processing section 18 is formed in the pattern section of the metal plate 1 with which exoergic components are arranged at least, and the insulating layer of the rear face of this level difference processing section 18 is set to 0.4mm. Moreover, less than 0.4mm, then said insulating layer can set to 0.4mm or more the height of the notching section 16 prepared in the point of a height 15 in all fields. It excels in a heat dissipation property and an insulating property by the above configuration, moreover substrate reinforcement is improved, and one shaping of the heat dissipation substrate excellent in the moldability can be attained. In this case, reduction of distributed capacity is still attained.

[0030] In addition, if the minimum value of an insulating bed depth is set up between 0.4mm and 0.6mm, a heat dissipation property will only deteriorate more than in this satisfactory in an insulating property and a moldability. Moreover, an insulating layer can be formed easily, without making the exposure of a metal plate 1 generate weld flash by arranging the gate section for slushing the compound insulating material 2 into the lower part of the part which made the insulating layer thin by said level difference processing.

[0031] It is to differ from drawing 6 in drawing 8 in the point of having formed the height 19 fixed to the 2nd metal mold 12. A height 19 is formed in the rear face of the pattern section of the metal plate 1 with which exoergic components are arranged at least, and makes thin the insulating layer formed of the compound insulating material 2 of high temperature conductivity of this part, and the effectiveness of it is the same as that of the case of drawing 7 . although a different point from drawing 7 needs to attach the same projection as a height 19 to an external radiator, level difference

processing of a metal plate 1 should abolish it -- even when a camber is in a heat dissipation substrate ****** and by making the projection of a radiator higher than a height 19, there is the description that the degree of adhesion of this part becomes good.

[0032] Differing from drawing 5 in drawing 9 is the point which formed the slot 20 in the metal plate 1. A slot 20 is formed in the perimeter of the inside of the outcrop of a metal plate 1 in the part which touches the height 14 prepared in the 1st metal mold 11. When a cavity 13 is filled up with the compound insulating material 2 of high temperature conductivity by this slot 20 and weld flash occurs between a metal plate 1 and a height 14, since weld flash is stopped in this slot 20, weld flash does not reach to the outcrop of a metal plate 1.

[0033] (Gestalt 3 of operation) Drawing 10 - drawing 15 explain the gestalt of operation of the 3rd of this invention below. Drawing 10 to drawing 15 is drawing for every production process of a heat dissipation substrate which carried the electronic parts which constitute a DC-DC converter as a gestalt of operation of the 3rd of this invention.

[0034] As first shown in drawing 10 , a metal plate 1 forms the predetermined circuit pattern which pierced and was united with the outer frame frame with processing. 22 is a bis-seat for fixing a heat dissipation substrate to a chassis or a radiator, and in case this bis-seat 22 pierces a metal plate 1, it is what was processed into coincidence, and it has performed level difference processing so that this base may moreover turn into a base of a heat dissipation substrate, and the same field. The metal plate 1 uses the copper plate of 0.5mm thickness as an ingredient [solder / it / and] with good thermal conductivity here.

[0035] Next, as shown in drawing 11 , a metal plate 1 is really fabricated on a heat dissipation substrate by the compound insulating material 2 of high temperature conductivity. It considered as the insert molding method by injection molding or transfer molding which slushes the compound insulating material 2 of high temperature conductivity which really fused [fixed in the metal mold which has the cavity of a substrate configuration] the metal plate 1 in metal mold in the condition as the approach of shaping. An element-placement part prepares a height in metal mold, and forms the cavity 5 for carrying the outcrop 4 and electronic parts 3 of a metal plate 1 for connecting electronic parts 3 electrically by fixing a metal plate 1 by this height. In drawing 11 , hatching shows the outcrop 4. Moreover, the terminal area 6 is reducing the touching area with the compound insulating material 2 of high temperature conductivity by fixing the top face and side face at the time of shaping, so that metal mold may be touched.

[0036] Next, it arranges to the cavity 5 which formed electronic parts 3 in the heat dissipation substrate as shown in drawing 12 , and connects with an outcrop 4 electrically. Soldering is performing as the electrical installation approach of electronic parts 3. Since the front face is not flat, this heat dissipation substrate has the approach of arranging the method of application by the dispenser, the method of application by imprint, and tabular solder as a configuration method of solder etc. The process which puts, heats and solders the heat dissipation substrate which has arranged solder and electronic parts 3 to the front face of said foil body 32 of the heating means constituted by the foil body 32 arranged on the front face of the liquid tub 31 in which the temperature control was carried out by the heat source 30, and said liquid tub 31 is used. A foil body 32 is used in order to improve adhesion with a heat dissipation substrate, while preventing that the ingredient of the liquid tub 31 adheres to a heat dissipation substrate. High heatproof plastic film, such as polyimide and Teflon, is arranged as a foil body 32 on the front face of the liquid tub 31 using molten metal, such as oil or solder specifically controlled to predetermined temperature, and a heat dissipation substrate is put, heated and soldered on this.

[0037] Although in the case of a reflow using a gaseous phase time amount will be taken before the large heat dissipation substrate of heat capacity reaches predetermined temperature, and excessive heat stress joins electronic parts 3 and the insulating composite material 2 of high temperature conductivity, since it is not heated by the electronic parts 3 on a heat dissipation substrate and a substrate beyond the temperature of the liquid tub 31 according to this approach, the heat stress to the compound insulating material 2 and electronic parts 3 of high temperature conductivity which constitute a heat dissipation substrate can be reduced sharply. Moreover, since the thermal conductivity of the substrate itself is excellent, heat transfer to solder is quick and soldering time amount can be shortened. It enables soldering time amount to shorten the liquid tub 31 further by

preheating in one tub as two tubs furthermore.
[0038] In addition, it cannot be overemphasized that the effectiveness that this soldering method of construction is the same also at heat dissipation substrates, such as a metal pace substrate and an alumina substrate, is acquired.
[0039] Next, as shown in drawing 13 , the outer frame frame of a metal plate 1 is separated, and a circuit pattern is made independent. It is also possible to perform the electric trial of a circuit in this condition. The bending lifting of a terminal area 6 is performed after that. At this time, the bending lifting section of a terminal area 6 is taken as the inside [appearance / of a heat dissipation substrate]. Beforehand, since this terminal area 6 is reducing the area which the compound insulating material 2 of high temperature conductivity touches with metal mold, exfoliation is easy the terminal area, and since the terminal area 6 which moreover has more than one is uniting with the compound insulating material 2 of high temperature conductivity, that positioning is easy for it. Moreover, since the creeping distance with the chassis and radiator which are connected to a rear face by starting a terminal area 6 inside an appearance is securable, it becomes possible to improve the withstand voltage from a circuit.
[0040] Next, as shown in drawing 14 , mold or casing is performed so that electronic parts 3 may be covered, where a part of terminal area 6 is exposed.
[0041] Drawing 15 is the perspective view of a heat dissipation substrate which changed the configuration of the metal plate 1 of drawing 11 , and the compound insulating material 2 of high temperature conductivity. Different points from drawing 11 in drawing 15 are the point that the heat dissipation substrate really fabricated the terminal area 6 which has more than one by the independent compound insulating material 2, and a point which has arranged the metal plate 1 alternately so that it may become predetermined spacing.
[0042] The compound insulating material Plastic solid with which 41 unifies a terminal area 6 in drawing 15 , and 42 are the opposite sections of a metal plate 1. It becomes it is possible to improve the relative-position precision and terminal reinforcement of a terminal area 6 with compound insulating material Plastic solid 41, and possible to specify distance with the heat dissipation substrate at the time of moreover inserting another substrate in a terminal. The opposite section 42 of a metal plate 1 can be improved in the reinforcement of a heat dissipation substrate in the condition of having insulated.
[0043]
[Effect of the Invention] As mentioned above, the heat dissipation substrate for electronic-parts loading of this invention pierces a metal plate in the shape of [predetermined] an arrangement pattern, and since this metal plate is really fabricated where an element-placement part is exposed at least by the compound insulating material of high temperature conductivity, it is constituted from it, and a circuit pattern is a metal plate, wiring resistance is low with a natural thing, and it is suitable for the high current circuit.
[0044] Moreover, once thermal diffusion of the generation of heat of the electronic parts mounted in this substrate is carried out by the metal plate, when attaching an external radiator in this substrate, the thermal resistance between said exoergic components and radiators is low [in order to radiate heat by the compound insulating material of high temperature conductivity, heat dissipation nature is good, and]. Since the insulating layer constituted from a compound insulating material of said high temperature conductivity by the improvement of this heat dissipation nature is made thickly, its insulation improves, and it is that the distributed capacity between patterns can also be reduced. Furthermore, since a metal plate is pierced and really fabricates the compound insulating material of high temperature conductivity to this using processing, it can be carried out easily, and with the conventional heat dissipation substrate, the difficult three-dimensional structure of it also becomes possible.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective view of the heat dissipation substrate for electronic-parts loading of the gestalt of 1 operation of this invention
[Drawing 2] This sectional side elevation
[Drawing 3] The perspective view in the condition of having arranged these electronic parts
[Drawing 4] The perspective view of the metal plate which is this important section
[Drawing 5] The sectional side elevation showing the manufacture approach of the heat dissipation substrate for electronic-parts loading of the gestalt other operations of this invention
[Drawing 6] The sectional side elevation of the shaping condition at the time of restoration of this compound insulating material
[Drawing 7] The sectional side elevation of this example of an improvement
[Drawing 8] The sectional side elevation explaining the shaping condition of this example of an improvement
[Drawing 9] The sectional side elevation explaining the shaping condition of this example of an improvement
[Drawing 10] The perspective view of the metal plate of the important section of the gestalt of other operations of this invention
[Drawing 11] The perspective view in the condition of having really fabricated by the compound insulating material which is this important section
[Drawing 12] The sectional side elevation explaining the wearing condition of these electronic parts
[Drawing 13] The perspective view of the substrate for electronic-parts loading which cut this metal plate and bent the terminal
[Drawing 14] The perspective view in the condition of having carried out mold shaping except for this terminal area
[Drawing 15] The perspective view in the condition of having really fabricated by the compound insulating material which is the important section of this example of an improvement
[Drawing 16] The perspective view of the conventional heat dissipation substrate for electronic-parts loading
[Drawing 17] This sectional side elevation
[Description of Notations]
1 Metal Plate
2 Compound Insulating Material
3 Electronic Parts
4 Outcrop
5 Cavity
6 Terminal Area
8 Height
9 Bending Section
11 1st Metal Mold
12 2nd Metal Mold
13 Cavity
14 Height

15 Height
16 Notching Section
17 Spring
18 Level Difference Processing Section
19 Height
20 Slot
22 Bis-Seat
30 Heat Source
31 Liquid Tub
32 Foil Body

[Translation done.]

* NOTICES *

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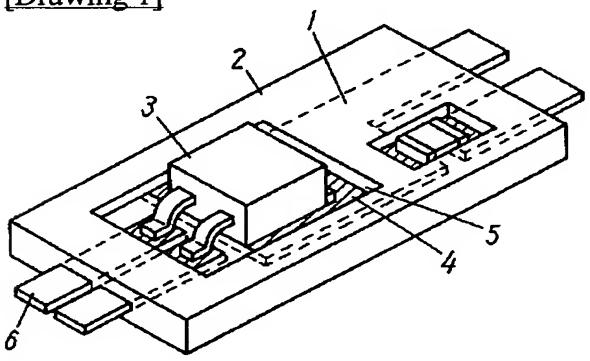
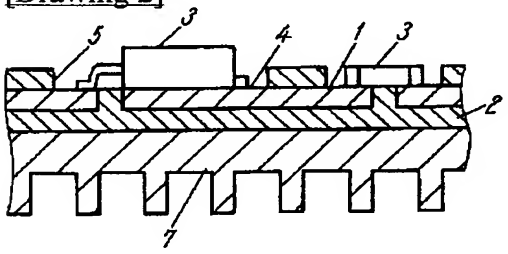
DRAWINGS

[Drawing 1]

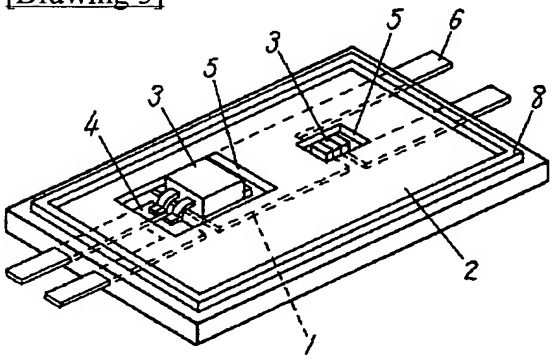


1 金属板
2 複合絶縁材料
3 電子部品
4 露出部

[Drawing 2]



[Drawing 3]



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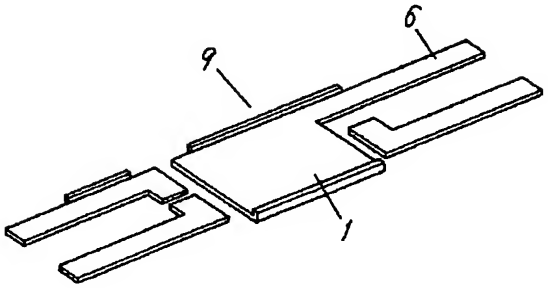
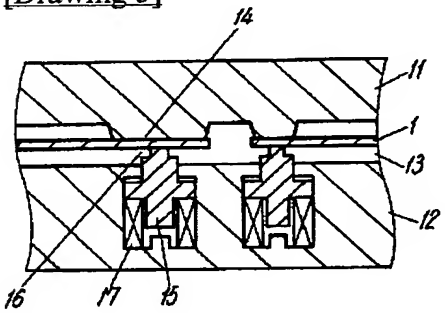
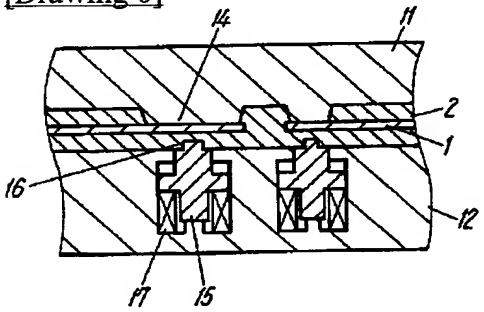


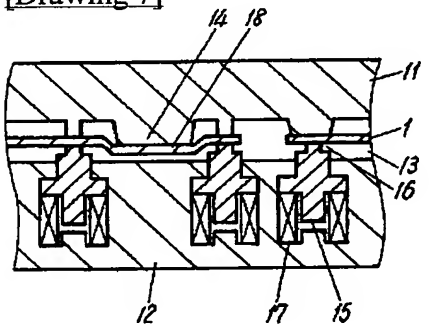
[Drawing 5]



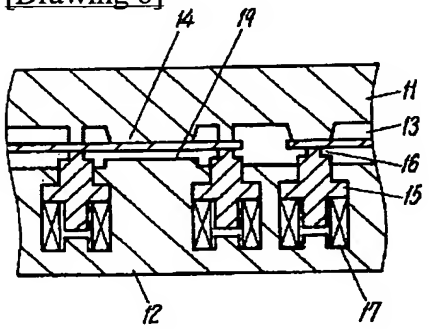
[Drawing 6]



[Drawing 7]



[Drawing 8]



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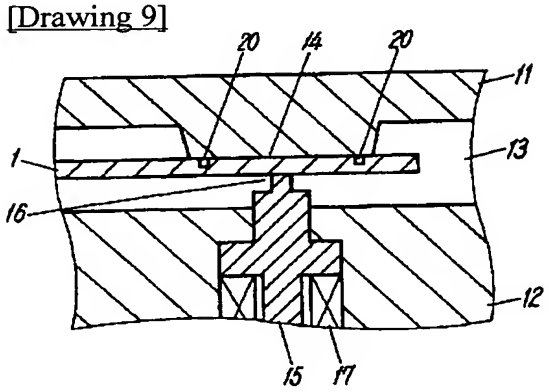
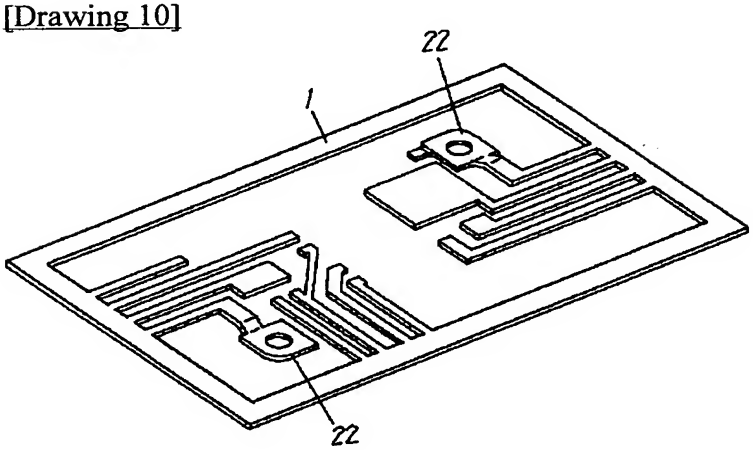
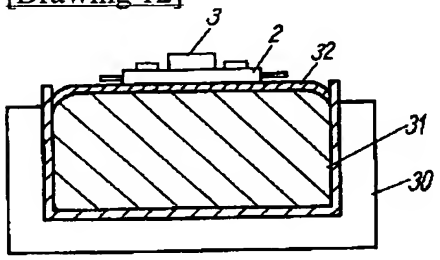


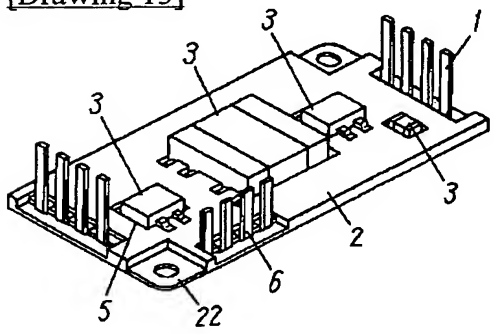
[Drawing 10]



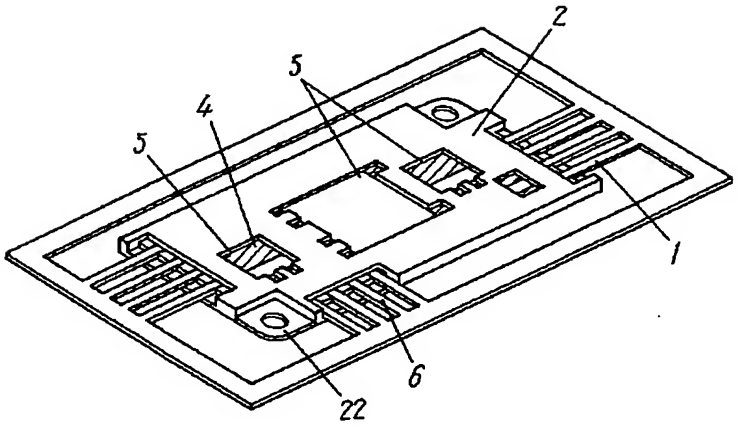
[Drawing 12]



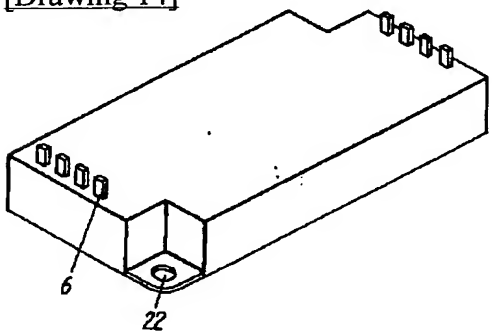
[Drawing 13]



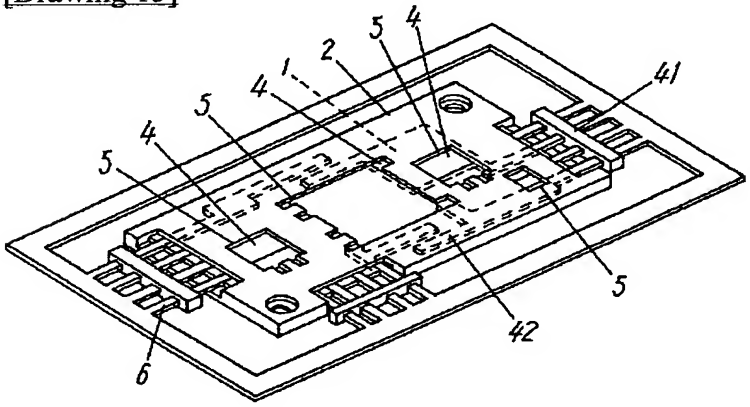
[Drawing 11]



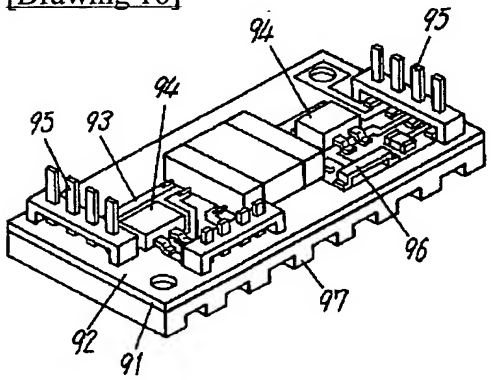
[Drawing 14]



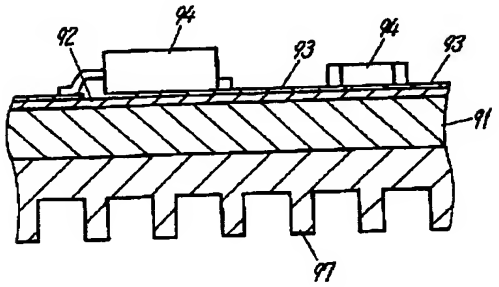
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号

特開平9－321395

(43)公開日　平成９年(1997)12月12日

(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｈ０５Ｋ	1/02			Ｈ０５Ｋ	1/02	Ｆ
	1/05				1/05	Ｚ
	3/00				3/00	Ａ

審査請求　未請求　請求項の数11　ＯＬ　（全 9 頁）

(21)出願番号　特願平8－136211

(22)出願日　平成８年(1996)５月30日

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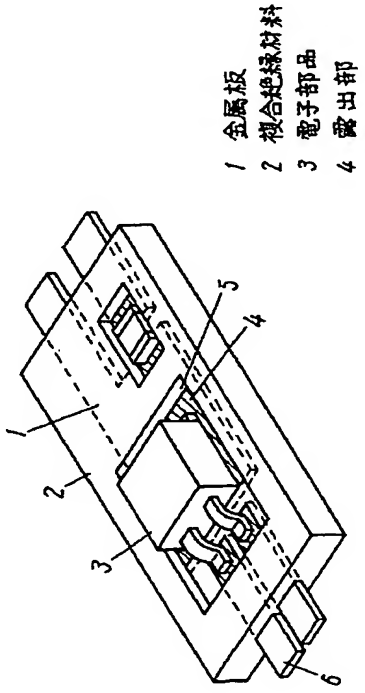
(54)【発明の名称】　電子部品搭載用放熱基板及びその製造方法

(57)【要約】

【課題】　本発明は多数の電子部品が高密度実装される電子部品搭載用放熱基板に関するものであり、発熱部品の放熱を効果的に行うモジュール用の電子部品搭載用放熱基板とその製造方法を提供することを目的とするものである。

【解決手段】　金属板１を所定の配線パターン状に打ち抜き、この金属板１を高熱伝導性の複合絶縁材料２により少なくとも電子部品３の部品搭載部分を露出部４とした状態で一体成形した。



【特許請求の範囲】
【請求項１】　所定の配線パターン状に打ち抜いた金属板と高熱伝導性の複合絶縁材料とにより構成され、前記高熱伝導性の複合絶縁材料は前記金属板をこの金属板の少なくとも部品搭載部分を露出させた状態で一体化形成した電子部品搭載用放熱基板。
【請求項２】　金属板の少なくとも部品搭載部分を露出させた状態でかつ部品収納可能なキャビティを構成するように前記金属板の上下両面に複合絶縁材料を一体形成した請求項１に記載の電子部品搭載用放熱基板。
【請求項３】　金属板の少なくとも部品搭載部分を露出させた状態で前記金属板の上下両面に配置するとともに表面に突起部を配置するように複合絶縁材料を一体形成した請求項２に記載の電子部品搭載用放熱基板。
【請求項４】　金属板は所定の配線パターン状に打ち抜くとともに少なくとも一部に折り曲げ加工あるいは絞り加工を施し、前記金属板の平面よりも突出させた請求項１に記載の電子部品搭載用高熱基板。
【請求項５】　金属板の少なくとも一部を露出させた状態で複合絶縁材料を一体形成し、前記金属板の一部を端子とした請求項１に記載の電子部品搭載用放熱基板。
【請求項６】　金属板は一体成形した高熱伝導性の複合絶縁材料の成形体の外形よりも内側で少なくともその一部を折り曲げて端子とした請求項５に記載の電子部品搭載用放熱基板。
【請求項７】　所定の配線パターン状に打ち抜いた金属板を金型に保持し、高熱伝導性の複合絶縁材料により一体成形する放熱基板を製造する方法において、前記金型のキャビティ内の前記金属板の部品搭載面側は少なくとも部品搭載部分を露出させかつ部品収納可能な形状の突起部により保持し、前記金属板の放熱面側の少なくとも外付けされる放熱器と絶縁を必要とする配線パターンについては可動する突起部により保持し、前記可動する突起部は金型のキャビティ内に前記高熱伝導性の複合絶縁材料が充填完了すると同時に移動させ、前記絶縁の必要な配線パターンは放熱面側に露出しないよう一体成形する電子部品搭載用放熱基板の製造方法。
【請求項８】　所定の配線パターン状に打ち抜いた金属板を金型に保持し、高熱伝導性の複合絶縁材料により一体成形する放熱基板を製造する方法において、前記所定の配線パターン状に打ち抜いた金属板の少なくとも一部に段差加工を施し前記高熱伝導性の複合絶縁材料により一体成形し前記高熱伝導性の複合材料よりなる絶縁層の厚みを部分的に変えた請求項７に記載の電子部品搭載用放熱基板の製造方法。
【請求項９】　所定の配線パターン状に打ち抜いた金属板を金型に保持し、高熱伝導性の複合絶縁材料により一体成形する放熱基板を製造する方法において、前記金属板は所定の配線パターン状に打ち抜くとともに前記部品搭載部分の露出部よりも内側に溝加工を形成した請求項７に記載の電子部品搭載用放熱基板の製造方法。
【請求項１０】　金属板を所定の配線パターン状に打ち抜く工程と、前記金属板を金型内に保持し、この金型に溶融した高熱伝導性の複合絶縁材料を流し込み、前記金属板を少なくとも部品搭載部分を露出させた状態で前記高熱伝導性の複合絶縁材料により基板上に一体成形する工程と、前記一体成形した基板に部品を電気的に接続する工程と、前記金属板の一部を折り曲げて端子に加工する工程と、ケースまたは樹脂により前記部品を覆う工程とによりなる電子部品搭載用放熱基板の製造方法。
【請求項１１】　少なくとも１つ以上の温度コントロールされた液体槽と前記液体槽の表面に配置した箔体により構成される加熱手段の前記箔体表面に半田と部品を配置した放熱基板を乗せて加熱し半田付けする電子部品搭載用放熱基板の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明はインバータ回路や電源回路のように大電力を扱う電子回路モジュール等に用いられるパワー半導体及び各種電子部品等を搭載する電子部品搭載用放熱基板及びその製造方法に関するものである。
【０００２】
【従来の技術】近年、インバータ回路や電源回路のように大電力を扱う電子回路は機器の小型化にともないモジュール化が進んでいる。このパワー電子回路のモジュール化を達成するためには、高密度実装されたパワー半導体等の損失による発熱をいかに放熱するかが重要な課題である。従来この種の電子回路モジュールには、金属支持板上の表面に薄い絶縁体層を介して導体箔を張り合わせ、この導体箔をエッチングすることにより配線パターンを形成する基板（以下金属ベース基板と称す）が用いられ、これにパワー半導体および各種電子部品を搭載して回路を形成していた。
【０００３】この従来の電子回路モジュールについて図１６、図１７により説明する。図１６及び図１７は従来の金属ベース基板を用いた電子回路モジュールを示すものである。同図によると、９１は金属支持板、９２は絶縁体層、９３は導体箔、９４はパワー半導体を含む電子部品である。導体箔９３は金属支持板９１に絶縁体層９２を介して張り合わされている。この導体箔９３はエッチングにより配線パターン状に形成され、これに電子部品９４を搭載し回路を構成する。９５は外部接続端子であり電子部品９４と同様に搭載される。電子部品９４での発熱は絶縁体層９２を介して金属支持板９１に伝えられる。９６はパターンの配線抵抗を低減するためのバスバー、９７は放熱器であり金属支持板９１のみの放熱では不十分な場合に放熱を補うために用いるものである。
【０００４】
【発明が解決しようとする課題】しかしながら上記従来

の構成では、配線パターンの形成をエッチングにより行うため、導体箔９３には３５μｍや７０μｍといった薄いものが用いられており、大電流が流れるようなパワー回路を構成する際にその配線抵抗が問題となる。このため電流の多く流れる部分にはバスバー９６を基板に実装している。またこの金属ベース基板の放熱特性は金属支持板９１と導体箔９３の間に形成された絶縁体層９２により決定され、一般的にこの種の絶縁体層９２はエポキシ樹脂の塗布により形成しており、放熱特性を良くするために薄く成形されている。このため絶縁特性が高くできないことや、導体箔９３と金属支持板９１との間に発生する分布容量が大きくなるために、回路の高周波化を阻害したり、金属支持板９１を介してノイズが伝搬し易いといった課題があった。さらに、モジュールを構成する場合の外部接続端子９５は別パーツで基板に実装する必要があり、複数の外部接続端子の位置決めが難しいといった課題も有していた。

【０００５】本発明は上記従来の課題を解決するもので、放熱基板の重要な特性である放熱特性と絶縁特性の両方を改善すると同時に大電力の電子回路を構成する上で重要となる配線抵抗の低減やノイズの原因となる配線パターンの分布容量の低減を達成し、外部接続端子なども一体化できる立体構造の可能な放熱基板であって、しかも容易に実現することのできる電子部品搭載用放熱基板及びその製造方法を提供することを目的とするものである。

【０００６】

【課題を解決するための手段】上記課題を解決するために本発明は、金属板を所定の配線パターン状に打ち抜き、この金属板を高熱伝導性の複合絶縁材料により少なくとも部品搭載部分を露出した状態で一体成形し放熱基板を構成するものである。

【０００７】この構成により、配線パターンは金属板であるために当然のことながら配線抵抗は低く、大電流回路に適している。またこの基板に実装された部品の発熱は一旦金属板により熱拡散された後、高熱伝導性の複合絶縁材料により放熱されるため放熱性が良好であり、また、高熱伝導性の複合絶縁材料で構成されるため絶縁層は厚くできるので絶縁性が向上し、パターン間の分布容量も低減が可能となる。さらに金属板は打ち抜き加工を用い、これに高熱伝導性の複合絶縁材料を一体成形するので容易に実施可能であり、従来の放熱基板では困難である立体的な構造も可能となるものである。

【０００８】

【発明の実施の形態】本発明の請求項１に記載の発明は、所定の配線パターン状に打ち抜いた金属板と高熱伝導性の複合絶縁材料とにより構成され、前記高熱伝導性の複合絶縁材料は前記金属板をこの金属板の少なくとも部品搭載部分を露出させた状態で一体形成したことにより、前記金属板によって熱拡散した後、高熱伝導性の絶縁材料によって放熱されるため、放熱性が良好となるとともに、前記配線パターンの分布容量も低減できるものである。

【０００９】本発明の請求項２に記載の発明は、請求項１に記載の複合絶縁材料により部品収納可能なキャビティを構成するものであり、搭載する電子部品の位置決めを容易とするものである。

【００１０】本発明の請求項３に記載の発明は、請求項１に記載の複合絶縁材料により電子部品搭載用放熱基板の表面周囲に突起部を設けたものであり、基板の強度向上、ケースとの嵌合部を極めて容易に形成できるものである。

【００１１】本発明の請求項４に記載の発明は、請求項１に記載の金属板を所定の配線パターン状に打ち抜くとともに少なくとも一部に折り曲げ加工あるいは絞り加工を施して前記金属板の平面よりも突出させたものであり、金属板によって放熱基板の強度向上を可能とするものである。

【００１２】本発明の請求項５に記載の発明は、請求項１に記載の金属板の一部を端子としたものであり、端子部を別途設ける必要のないものである。

【００１３】本発明の請求項６に記載の発明は、請求項５に記載の金属板を一体成形した高熱伝導性の複合絶縁材料の成形体の外形よりも内側で少なくともその一部を折り曲げて端子としたものであり、裏面に接続されるシャーシや放熱器との沿面距離を確保して、回路からの絶縁耐圧を向上させるものである。

【００１４】本発明の請求項７に記載の発明は、所定の配線パターン状に打ち抜いた金属板を金型に保持し、高熱伝導性の複合絶縁材料により一体成形する放熱基板を製造する方法において、前記金型のキャビティ内の前記金属板の部品搭載面側は少なくとも部品搭載部分を露出させかつ部品収納可能な形状の突起部により保持し、前記金属板の放熱面側の少なくとも外付けされる放熱器と絶縁を必要とする配線パターンについては可動する突起部により保持し、前記可動する突起部は金型のキャビティ内に前記高熱伝導性の複合絶縁材料が充填完了すると同時に移動させ、前記絶縁の必要な配線パターンは放熱面側に露出しないよう一体成形するものであり、極めて効率よく、電子部品搭載用放熱基板を製造できるものである。

【００１５】本発明の請求項８に記載の発明は、請求項７の所定の配線パターン状に打ち抜いた金属板を金型に保持し、高熱伝導性の複合絶縁材料により一体成形する放熱基板を製造する方法において、前記所定の配線パターン状に打ち抜いた金属板の少なくとも一部に段差加工を施して、前記高熱伝導性の複合絶縁材料により一体成形し、前記高熱伝導性の複合材料よりなる絶縁層の厚みを部分的に変えたものであり、発熱部品の配置される部品の放熱特性を向上させたり、基板強度の向上が図れる

ものである。

【００１６】本発明の請求項９に記載の発明は、請求項７の所定の配線パターン状に打ち抜いた金属板を金型に保持し、高熱伝導性の複合絶縁材料により一体成形する放熱基板を製造する方法において、前記金属板は所定の配線パターン状に打ち抜くとともに部品搭載部分の露出部よりも内側に溝加工を形成したものであり、露出部内への成形時の複合絶縁材料の侵入を防止するものである。

【００１７】本発明の請求項１０に記載の発明は、金属板を所定の配線パターン状に打ち抜く工程と、前記金属板を金型内に保持し、この金型に溶融した高熱伝導性の複合絶縁材料を流し込み、前記金属板を少なくとも部品搭載部分を露出させた状態で前記高熱伝導性の複合絶縁材料により基板上に一体成形する工程と、前記一体成形した基板に部品を電気的に接続する工程と、前記金属板の一部を折り曲げて端子に加工する工程と、ケースまたは樹脂により前記部品を覆う工程とで構成されるものであり、効率よく電子部品を搭載した電子部品搭載用放熱基板を製造できるものである。

【００１８】本発明の請求項１１に記載の発明は、少なくとも１つ以上の温度コントロールされた液体槽と前記液体槽の表面に配置した箔体により構成される加熱手段の前記箔体表面に半田と部品を配置した放熱基板を乗せて加熱し半田付けするものであり、箔体によって液体槽内の液材料の付着を防止するとともに、放熱基板との密着性を向上するものである。

【００１９】以下、本発明の一実施の形態について、図１～図１５により説明する。

（実施の形態１）図１、図２は第１の実施の形態の電子部品搭載用放熱基板を示す図であり、図１は斜視図、図２は断面図である。図１において、１は配線パターン状に打ち抜いた金属板で、金属板１としては熱伝導率及び導電率の良好な銅板が望ましく、配線パターン状に打ち抜き加工する手段としてはプレス機を用いることにより容易に実現できる。２は高熱伝導性の複合絶縁材料で、これは射出成形やトランスファ成形により金属板１のインサート成形ができる材料であり、ベースの樹脂材料として電子部品の半田付けが可能なよう高耐熱性を有する熱硬化性のエポキシ樹脂あるいは、熱可塑性のポリフェニレンサルファイド、液晶ポリマー、ポリスチレン、ナイロンのいずれかあるいはこれらの混合物を用い、このベース樹脂材料に絶縁性と高熱伝導率を有する酸化アルミ、窒化アルミ、酸化マグネシウム、窒化ボロン、酸化亜鉛、シリカ、チタニア、スピネル等のいずれかあるいはこれらの中より選択された混合物をチタニウム、シランなどのカップリング剤で表面処理した粉体フィラーとガラスやウィスカーなどの繊維状のフィラーとを主体とする充填剤を混練して熱伝導性と強度を高めた複合絶縁材料である。

【００２０】３は放熱基板に搭載された電子部品、４は電子部品３を電気的に接続するための金属板１の露出部、５は電子部品３を搭載するためのキャビティ、６は金属板１を用いた端子部である。図２において、７は放熱基板のみでは放熱が十分でない時に用いる外付けの放熱器である。このような高熱伝導性の複合絶縁材料２により配線パターン状に打ち抜いた金属板１を電子部品３の搭載部分を露出させた状態で一体化成形している。

【００２１】以上のように構成された放熱基板は配線パターンが打ち抜き加工された金属板１であるため配線抵抗が低く、実装された電子部品３の発熱は配線パターン状に打ち抜いた金属板１により熱拡散された後、高熱伝導性の複合絶縁材料２によって放熱されるため放熱特性に優れている。また外付けの放熱器７を用いる場合においても絶縁層が厚いため絶縁特性は良好であり、パターン間の分布容量も低減が可能となる。さらに金属板１の部品実装部分を露出させ、高熱伝導性の複合絶縁材料２により搭載用のキャビティ５を構成することにより部品の位置決めが容易となるとともに、半田ブリッジの防止用のレジストが不要となる。

【００２２】また、金属板１は高熱伝導性の複合絶縁材料２によりモールドされるため密着度が向上するとともに、金属板１の両側に高熱伝導性の複合絶縁材料２が配置されるので成形後の樹脂の収縮に伴う基板のソリが低減される、といった基板構成上の利点を有するものである。さらに従来の基板表面に形成された配線パターンはパターン間の絶縁確保のため、所定の沿面距離を確保する必要があったが、本構成によれば配線パターンは高熱伝導性の複合絶縁材料２に埋め込まれるのでパターン間隔を狭めることも可能となる。

【００２３】図３、図４に第１の実施の形態に改善を行った例を示す。図３は放熱基板の表面に高熱伝導性の複合絶縁材料２による枠状の突起部８を設けた例を示す。このような突起部８を構成することにより放熱基板の強度向上や絶縁に必要な沿面距離の確保及びケース等との嵌合部の構成といった様々の機能を持たせることも可能であり、しかも金型によりこれらの構成は容易に達成可能である。

【００２４】図４は金属板１に折り曲げ加工部９を設けた例を示す。このような折り曲げ加工や絞り加工により放熱基板の強度向上を行うことができる。また、このような金属板１の加工によっても電子部品３の位置決め機能を持たせることも可能である。この種の加工もプレスの金型により配線パターンの形成と同時に構成できる。このように本構成の放熱基板は従来の放熱基板では困難であった立体的な加工を容易に実現できる。

【００２５】なお、金属板１としての銅板の厚みは熱拡散効果と端子を構成したときの強度を考慮すると０．５mm以上が望ましく、プレス機を用いて金型によりパターン形成する場合の加工性を考慮すると１．０mm以下

が望ましい。また銅板の部品実装面は鍍金することにより半田付け性を良好とすることができ、底面を黒化処理やブラスト処理により表面を荒らすことで金属板１と高熱伝導性の複合絶縁材料２との密着性は改善される。さらに金属板１のパターン面積が広い場合には部分的に穴加工を施しておくことにより一体成形時に高熱伝導性の複合絶縁材料２が前記穴加工部にまで入り込むためさらに密着性を改善できる。

【００２６】（実施の形態２）以下本発明の第２の実施の形態として一体成形方法について図面を参照しながら説明する。図５、図６は（実施の形態１）の一体成形方法を示す断面図である。図５において、１は配線パターン状に打ち抜いた金属板、１１は第１の金型、１２は第２の金型、１３は第１の金型１１及び第２の金型１２に設けたキャビティ、１４は第１の金型１１に設けた金属板１を固定するための突起部、１５は第２の金型１２に設けた金属板１を固定するための突起部、１６は突起部１５の先端部に設けた切り欠き部、１７は突起部１５が第２の金型１２より突出した状態を保持するためのバネである。図６において２はキャビティ１３に流し込んだ高熱伝導性の複合絶縁材料である。

【００２７】以上のように構成された金型を用いての一体成形方法について具体的に説明する。金属板１は第１の金型１１に設けられた突起部１４と第２の金型１２に設けられた突起部１５によりキャビティ１３内で保持される。この状態でキャビティ１３に溶融した高熱伝導性の複合絶縁材料２を流し込むことにより金属板１と高熱伝導性の複合絶縁材料２の一体成形が達成される。ここで突起部１４を部品収納可能な形状とすることにより金属板１の一部を露出させかつ高熱伝導性の複合絶縁材料２の成形体に部品収納可能なキャビティ１３を構成できる。また突起部１５はその先端部に設けた切り欠き部１６に溶融した高熱伝導性の複合絶縁材料２がキャビティ１３内に充填完了した後圧力が加わり押し下げられる。これにより金属板１には突起部１５の移動量に応じた厚みの高熱伝導性の複合絶縁材料２が配置されるので金属板１はこの面に露出しない。

【００２８】なお、突起部１５は外部より機械的にスライドさせることも可能でありこの時切り欠き部１６は不要となる。

【００２９】図７、図８、図９は前述の一体成形方法について改善した例を示す断面図である。図７、図８、図９において図５、図６と同一のものについては同一の番号を付してその説明を省略して説明すると、図７において図５と異なる点は金属板１に段差加工部１８を設けた点にある。金属板１の裏面に高熱伝導性の複合絶縁材料２により形成される絶縁層はその絶縁特性及び樹脂強度より０．４ｍｍ以上が望ましい。しかし金属板１の全ての裏面を０．４ｍｍとした場合充填剤の添加によって粘度の高くなった高熱伝導性の複合絶縁材料２を充填させることが困難であると同時に基板強度が弱くなる。また前記絶縁層を厚くすると放熱特性が悪化するため極力薄くしたいといった相反の課題を有している。そこで少なくとも発熱部品の配置される金属板１のパターン部に段差加工部１８を設け、この段差加工部１８の裏面の絶縁層を０．４ｍｍとする。また突起部１５の先端部に設けた切り欠き部１６の高さを０．４ｍｍ以内とすれば前記絶縁層は全ての領域において０．４ｍｍ以上とすることができる。以上の構成により放熱特性と絶縁特性に優れ、しかも基板強度を向上し、成形性に優れた放熱基板の一体成形が達成できる。この場合分布容量はさらに低減可能となる。

【００３０】なお、絶縁層厚みの最小値は０．４ｍｍから０．６ｍｍの間に設定すれば絶縁特性、成形性に問題なく、これ以上では放熱特性が劣化するだけである。また前記段差加工により絶縁層を薄くした部分の下部に複合絶縁材料２を流し込むためのゲート部を配置することにより金属板１の露出面にバリを発生させることも無く容易に絶縁層を形成できる。

【００３１】図８において図６と異なるのは第２の金型１２に固定された突起部１９を設けた点にある。突起部１９は少なくとも発熱部品の配置される金属板１のパターン部の裏面に設け、この部分の高熱伝導性の複合絶縁材料２により形成される絶縁層を薄くするものであり、効果は図７の場合と同様である。図７と異なる点は外付けの放熱器に突起部１９と同様な突起を付ける必要があるが金属板１の段差加工がなくせることや、放熱器の突起を突起部１９よりも高くすることにより放熱基板にソリがある場合でもこの部分の密着度が良好となるといった特徴がある。

【００３２】図９において図５と異なるのは金属板１に溝部２０を形成した点である。溝部２０は第１の金型１１に設けられた突起部１４に接する部分で金属板１の露出部の内側周囲に形成する。この溝部２０により高熱伝導性の複合絶縁材料２をキャビティ１３に充填した際に金属板１と突起部１４との間にバリが発生した場合においてもバリはこの溝部２０で止められるため金属板１の露出部までバリが及ぶことはない。

【００３３】（実施の形態３）以下本発明の第３の実施の形態について図１０～図１５により説明する。図１０から図１５は本発明の第３の実施の形態としてＤＣ－ＤＣコンバータを構成する電子部品を搭載した放熱基板の製造工程毎の図である。

【００３４】まず図１０に示すように、金属板１は打ち抜き加工により外枠フレームで一体となった所定の配線パターンを形成する。２２は放熱基板をシャーシや放熱器に固定するためのビス座であり、このビス座２２は金属板１を打ち抜く際同時に加工したもので、しかもこの底面が放熱基板の底面と同一面となるよう段差加工を施している。ここで金属板１は半田付けが可能でかつ熱伝

導率の良好な材料として０．５mm厚の銅板を用いている。

【００３５】次に図１１に示すように、金属板１を高熱伝導性の複合絶縁材料２により放熱基板上に一体成形する。一体成形の方法としては金属板１を基板形状のキャビティを有する金型内に固定し、その状態で金型内に溶融した高熱伝導性の複合絶縁材料２を流し込む射出成形あるいはトランスファー成形によるインサート成形法とした。部品搭載部分は金型に突起部を設け、この突起部により金属板１を固定することにより電子部品３を電気的に接続するための金属板１の露出部４と電子部品３を搭載するためのキャビティ５を形成している。図１１において露出部４はハッチングにより示している。また端子部６は成形時にその上面及び側面を金型に接するように固定することにより高熱伝導性の複合絶縁材料２との接する面積を低減している。

【００３６】次に図１２に示すように電子部品３を放熱基板に形成したキャビティ５に配置し露出部４に電気的に接続を行う。電子部品３の電気的接続方法としては半田付けにより行っている。この放熱基板は表面が平坦ではないので半田の配置方法としてはディスペンサーによる塗布方法、転写による塗布方法及び板状の半田を配置する方法等がある。熱源３０により温度コントロールされた液体槽３１と前記液体槽３１の表面に配置した箔体３２により構成される加熱手段の前記箔体３２の表面に半田と電子部品３を配置した放熱基板を乗せて加熱し半田付けする工程を用いている。箔体３２は放熱基板に液体槽３１の材料が付着することを防止すると共に放熱基板との密着性を向上するために用いるものである。具体的には所定の温度にコントロールしたオイルまたは半田等の溶融金属を用いた液体槽３１の表面に箔体３２としてポリイミドやテフロン等の高耐熱プラスチックフィルムを配置し、この上に放熱基板を乗せて加熱し半田付けするものである。

【００３７】気相を用いたリフローの場合、熱容量の大きい放熱基板が所定の温度に達するまでに時間がかかり電子部品３や高熱伝導性の絶縁複合材料２に過大な熱ストレスが加わるが、この方法によれば放熱基板及び基板上の電子部品３には液体槽３１の温度以上には加熱されないので放熱基板を構成する高熱伝導性の複合絶縁材料２や電子部品３に対する熱ストレスを大幅に低減できる。また基板自体の熱伝導性が優れているために半田への熱伝達が速く半田付け時間が短縮できる。さらに液体槽３１を２つの槽として一方の槽にてプリヒートを行うことにより半田付け時間はさらに短縮することが可能となる。

【００３８】なお、この半田付け工法は金属ベース基板やアルミナ基板等の放熱基板でも同様の効果が得られることはいうまでもない。

【００３９】次に図１３に示すように、金属板１の外枠フレームを切り放し配線パターンを独立化する。この状態で回路の電気的試験を行うことも可能である。その後端子部６の曲げ起こしを行う。この時、端子部６の曲げ起こし部は放熱基板の外形よりも内側とする。予めこの端子部６は金型により高熱伝導性の複合絶縁材料２の接する面積を低減しているために剥離は容易であり、しかも、複数ある端子部６は高熱伝導性の複合絶縁材料２と一体化していることからその位置決めは容易である。また端子部６を外形よりも内側で曲げ起こすことにより裏面に接続されるシャーシや放熱器との沿面距離を確保できるため回路からの絶縁耐圧を向上することが可能となる。

【００４０】次に図１４に示すように、端子部６の一部を露出させた状態で電子部品３を覆うようにモールドまたはケーシングを行う。

【００４１】図１５は図１１の金属板１及び高熱伝導性の複合絶縁材料２の構成を変更した放熱基板の斜視図である。図１５において図１１と異なる点は複数ある端子部６を放熱基板とは独立した複合絶縁材料２により一体成形した点と、金属板１を所定の間隔となるよう互い違いに配置した点である。

【００４２】図１５において４１は端子部６を一体化する複合絶縁材料成形体、４２は金属板１の対向部である。複合絶縁材料成形体４１により端子部６の相対位置精度及び端子強度を向上することが可能であり、しかも端子に別基板を挿入した際の放熱基板との距離を規定することが可能となる。金属板１の対向部４２は絶縁された状態で放熱基板の強度を向上することが可能である。

【００４３】

【発明の効果】以上のように本発明の電子部品搭載用放熱基板は金属板を所定の配置パターン状に打ち抜き、この金属板を高熱伝導性の複合絶縁材料により少なくとも部品搭載部分を露出させた状態で一体成形して構成しているために、配線パターンは金属板であるために当然のことながら配線抵抗は低く、大電流回路に適している。

【００４４】また、この基板に実装された電子部品の発熱は一旦金属板により熱拡散された後、高熱伝導性の複合絶縁材料により放熱されるため放熱性が良好であり、この基板に外付けの放熱器を取り付ける場合においても前記発熱部品と放熱器の間の熱抵抗は低い。この放熱性の改善により前記高熱伝導性の複合絶縁材料で構成される絶縁層は厚くできるので絶縁性が向上し、パターン間の分布容量も低減が可能となる。さらに金属板は打ち抜き加工を用いこれに高熱伝導性の複合絶縁材料を一体成形するので容易に実施可能であり、従来の放熱基板では困難である立体的な構造も可能となるものである。

【図面の簡単な説明】

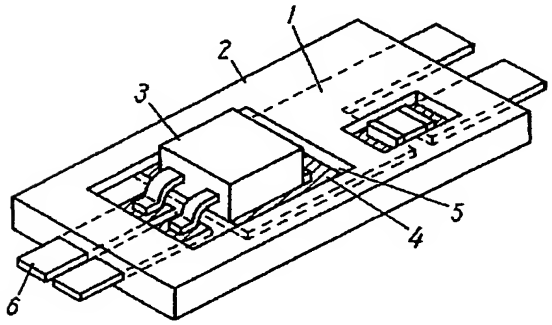
【図１】本発明の一実施の形態の電子部品搭載用放熱基板の斜視図

【図２】同側断面図

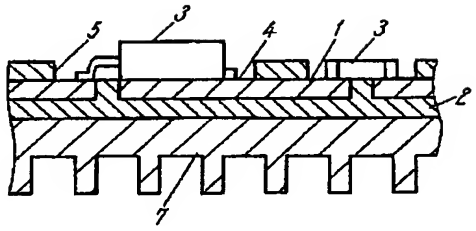
【図３】同電子部品を配置した状態の斜視図
【図４】同要部である金属板の斜視図
【図５】本発明の他の実施の形態の電子部品搭載用放熱基板の製造方法を示す側断面図
【図６】同複合絶縁材料の充填時の成形状態の側断面図
【図７】同改善例の側断面図
【図８】同改善例の成形状態を説明する側断面図
【図９】同改善例の成形状態を説明する側断面図
【図１０】本発明の他の実施の形態の要部の金属板の斜視図
【図１１】同要部である複合絶縁材料で一体成形した状態の斜視図
【図１２】同電子部品の装着状態を説明する側断面図
【図１３】同金属板を切断して端子を折曲した電子部品搭載用基板の斜視図
【図１４】同端子部を除き、モールド成形した状態の斜視図
【図１５】同改善例の要部である複合絶縁材料で一体成形した状態の斜視図
【図１６】従来の電子部品搭載用放熱基板の斜視図
【図１７】同側断面図
【符号の説明】

１　金属板
２　複合絶縁材料
３　電子部品
４　露出部
５　キャビティ
６　端子部
８　突起部
９　折り曲げ部
１１　第１の金型
１２　第２の金型
１３　キャビティ
１４　突起部
１５　突起部
１６　切り欠き部
１７　バネ
１８　段差加工部
１９　突起部
２０　溝部
２２　ビス座
３０　熱源
３１　液体槽
３２　箔体

【図１】

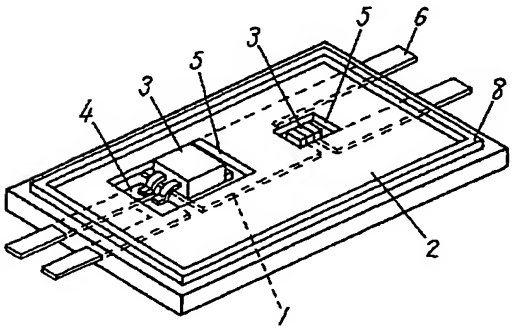


【図２】



1　金属板
2　複合絶縁材料
3　電子部品
4　露出部

【図３】



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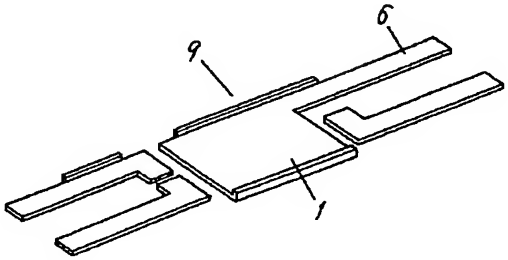

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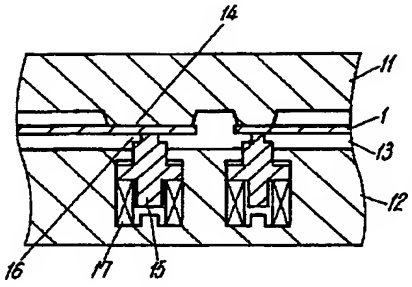
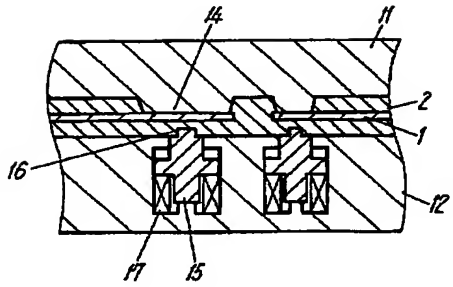


【図６】



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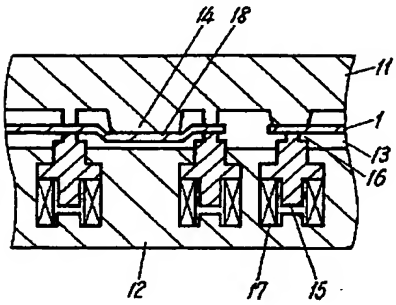

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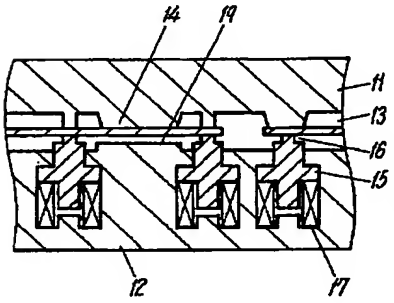

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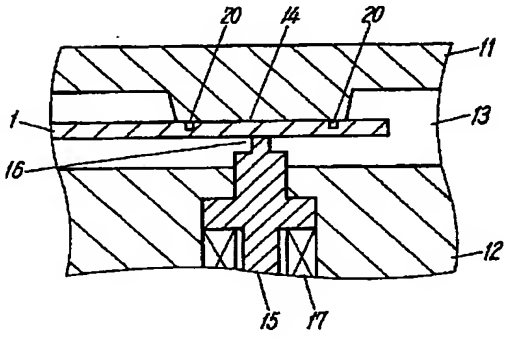
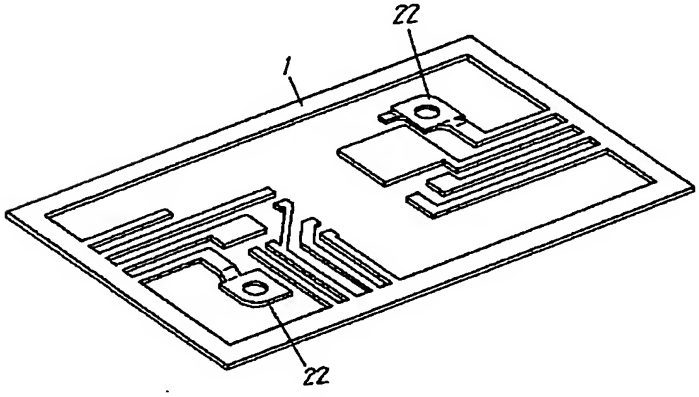
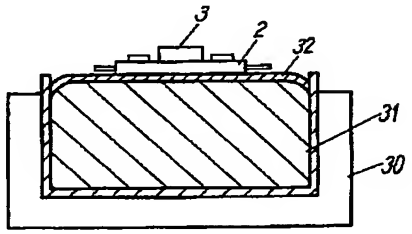


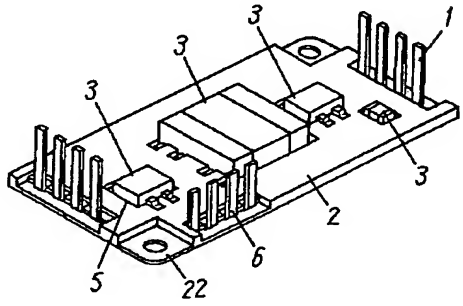
【図１０】



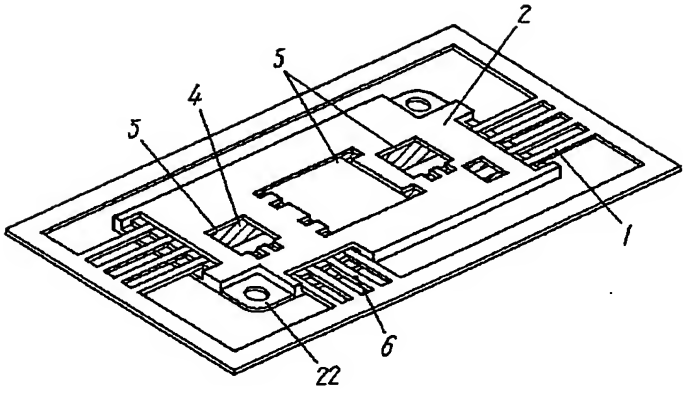
【図１２】



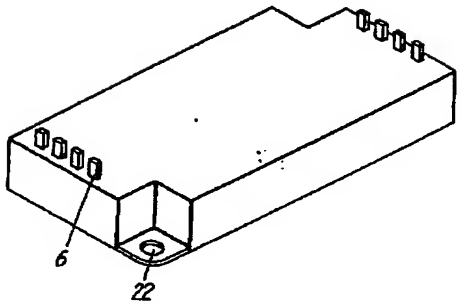
【図１３】



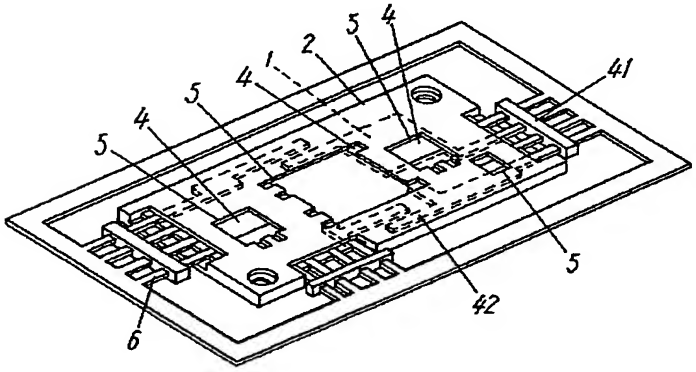
【図１１】



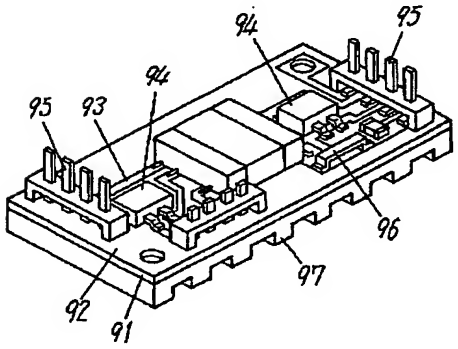
【図１４】



【図１５】



【図１６】



【図１７】